4.0 Past Environmental Management Practices

PORTS operations have resulted in the release of a variety of contaminants into the environment through stack and diffuse air emissions; from discharges through sewers into lagoons, local ditches, and streams; through accidental releases; and from past waste disposal practices, such as the burial of low-level and hazardous waste.

Requirements governing the release of chemicals and radionuclides into the environment were limited in the early years of PORTS operations. The AEC established allowable limits for the release of radionuclides into the environment, but Federal and state agencies had few restrictions on discharge and disposal activities until the late 1960s. Releases from U.S. industrial operations during the 1950s and 1960s, including those at PORTS, were significant. Past PORTS operations and spills resulted in the release of radionuclides and chemicals in the vicinity of the Plant and the transport of these contaminants to local streams and groundwater. In 1989, DOE entered into legally binding agreements with EPA and the State of Ohio to remediate the site. Significant activities are still ongoing at Portsmouth to complete the actions governed by these agreements.

ENVIRONMENTAL MANAGEMENT PRACTICES

- ***Waste Management***
- ***Management and Disposal of Scrap and Surplus Materials***
- ***Liquid Effluents***
- ***Atmospheric Releases of Radioactivity and Fluorine/Fluorides***

4.1 Waste Management

- *Solid Waste Disposal*
- *Hazardous Waste Management*
- *Radioactive Waste Management*

During construction and subsequent operations at PORTS, various waste materials were generated that required storage, treatment, and disposal, either on site or at offsite disposal locations. Over the operating lifetime of the Plant, activities to manage these wastes evolved in response to internal and external requirements. The earliest of these requirements addressed controls for solid waste (trash), radioactively contaminated burnable and non-burnable waste, and highly contaminated radioactive waste. In the late 1970s and 1980s, requirements expanded to include hazardous waste (first PCBs, followed by RCRA-defined wastes), as well as tighter controls on contaminated radioactive waste. The organizational approach to performing these waste management functions also evolved from one in which several organizations managed the waste streams they each generated to an integrated approach that began in 1991 under the Waste Management Division.

A construction waste disposal area, operated by the PORTS construction contractor (Peter Kiewit), was the first of the site's disposal facilities and burial sites to be established. This was followed by development of ponds and pits, landfills, incinerators, classified waste burial grounds, and a waste oil biodegradation area. (Table 1 shows the facilities used for solid and containerized waste; ponds and pits are discussed in Section 4.3.) All these sites have been closed, and several are still being investigated and/or remedied under the RCRA closure process. However, interviews with current and former workers and review of historical documents indicated a number of additional locations where disposal or storage activities may have occurred. These locations, discussed in Volume 2, were referred to Plant management for further evaluation.

Solid Waste Disposal

During Plant construction, the construction contractor used the construction waste disposal area south of the main Plant buildings for solid

Table 1. Solid Waste Management Treatment and Disposal Facilities

Facility Name	Operating Period	Material/Waste	Status
Peter Kiewit Landfill	1954 to 1968	Construction waste, sanitary waste	Solid waste closure
X-734 Spoils Area	1982 to 1985	Construction waste, plastic containers, waste drums, chemical product containers	Solid waste closure; inert capped according to State of Ohio solid waste regulations
X-735 Sanitary Landfill	1981 to 1997	Sanitary waste, sewage plant coarse screenings, asbestos, floor sweepings in southern portion; northern portion also received solvent-soaked rags	Northern portion of the landfill closed as a RCRA Subtitle C Unit; southern portion closed according to State of Ohio solid waste regulations
X-231A Oil Biodegradation Plot	1971 to 1977	Uranium-contaminated waste oil, solvent-contaminated waste oil, oil-soaked fuller's earth, chlorinated solvents	Temporarily capped in 1987 as part of an interim remedial measure
X-231B Oil Biodegradation Plot	1976 to1983	Uranium-contaminated waste oil, PCBs, solvents	Temporarily capped in 1987 as part of an interim remedial measure
X-749 Contaminated materials disposal facility	Northern portion operated 1955-1990; southern portion operated 1986-1990	Alumina-trap residue, sodium fluoride, incinerator ash with trace quantities of neptunium and plutonium, chemical trap material contaminated with technetium-99, metal hydroxide sludge from the X-705 raffinate, contaminated roofing	RCRA closure activities included installing slurry walls and groundwater collection trenches in 1991; a multi-layer cap placed over the entire Landfill in 1992; landfill received RCRA certification in 1993
X-749A Classified	1955 to 1993	Classified records; tube sheets; classified floor sweepings; compressor blades; other classified parts; nickel plant; metal shapes clad with either zirconium, a zirconium alloy, or hafnium	Unit capped according to State of Ohio solid waste regulations in 1994; being monitored
X-705B Incinerators	1950s to 1986	Contaminated solid burnable waste, classified waste, classified floor sweepings, plastic contaminated waste, used oils and solvents	Dismantled and removed
Smelter	1961 to 1983	Contaminated aluminum	Closed
X-705 Salamanders	1950s to 1970s	Contaminated-waste oils and solvents	Closed

waste disposal. This location, named after the construction contractor, was called the Peter Kiewit landfill. Following construction, this area became the site's landfill and was operated until 1968. Because of the continuing need for a construction spoils area, the X-734 landfill was established. In 1982, controls for the operation of X-734 were developed, specifying that no radioactive, toxic, or environmentally hazardous substances would be permitted. Although no metal or plastic containers were to be accepted for burial, a 1985 user questionnaire and an environmental audit discovered that the area was, in fact, receiving plastic, chemical product containers, and waste drums. As a result, this area was closed in 1985. Waste materials were then sent to the X-735 landfill, where tighter controls on waste receipt were in place.

General guidelines for generating, containerizing, handling, storing, and disposing of waste were in place even in the early days of the Plant, as indicated by the issuance of an operating method (SPP R-2, "Waste Management") in July 1955. Since a radioactively-contaminated landfill was also used from the early days of Plant operation, the sanitary landfills received only slightly contaminated material, including floor sweepings from the process buildings that were contaminated. In addition, waste was segregated based on the desire to recover enriched uranium, and there was no strict enforcement on many radioactive waste streams that had little recoverable uranium. In the earlier years, sanitary waste was generated from office and cafeteria locations, flooring sweepings, ash from the coal plant, and liquid industrial waste.

By 1968, the Plant had ceased open burning of combustible wastes and established the X-735 sanitary landfill. OR evaluations in the 1970s and early 1980s indicated that this landfill was operated effectively. In

X-752 Scrap Yard with X-734 Spoils Area Directly Behind

X-735 Landfill Area

1981, a specific maintenance method for operating the sanitary landfill was implemented, which prohibited burning of waste materials. This procedure allowed receipt of coarse screenings from the sewage treatment plant, but forbade sewage sludge. Conventional solid waste was disposed of in this landfill, as well as asbestos (in designated and segregated cells). Over time, tighter controls and limits were also adopted for receipt of radioactive material (e.g., the limit set for uranium and technetium was less than 3 ppm for disposal in the X-735 landfill).

As new requirements were enacted, additional items were restricted from the X-735 landfill, including hazardous waste. As part of these new requirements, the landfills were permitted by both the Pike County Health Department and the Ohio EPA in 1989. In addition, internal and external inspections evaluated the effectiveness of controls. These inspections identified numerous concerns about the disposal of non-permitted material, culminating in a 1990 OR surveillance that determined that rags used to remove solvents in the X-720 paint shop were disposed of in the X-735 landfill. As a result, shipment of waste from the PORTS shop areas to the landfill was banned, and part of the landfill had to undergo RCRA hazardous waste facility closure. In late 1991, the Martin Marietta Utility Services Waste Management Division established "Waste Management Information Notification Bulletins" to educate PORTS personnel regarding specific items that were prohibited from disposal in the landfill.

In the early 1990s, increased regulatory requirements mandated the need for a new landfill. However, after Plant operations were split between DOE and USEC, USEC opted to use an offsite vendor

for disposal of solid waste. As a result, DOE elected not to construct a new landfill, and to close X-735 and ship solid waste to the Pike County landfill, beginning in 1998.

Hazardous Waste Management

In 1970, in response to increased waste management activities, the Power and Utilities superintendent recommended the establishment of a pollution coordinator and creation of a pollution control committee. Previously, the Chemical Operations Division had responsibility for hazardous and toxic material disposal. Liquid waste for most industrial operations was primarily discharged to wastewater treatment and recovery systems as discussed in Section 4.3. In some cases, waste solvents were deliberately dumped on the ground outside of some buildings by maintenance personnel. As a result, the amount of hazardous waste that was containerized for disposal was very limited. As new requirements placed restrictions on the use of these facilities and systems, the Health Protection organization expanded the scope of its responsibilities to include environmental compliance activities. Additional requirements resulted in the formation of a waste management organization within the Environmental Control Department, which worked with Chemical Operations. By 1986, the Environmental Control Department had the lead responsibility for waste management; as the program continued to expand, Waste Management became a separate division.

Contaminated oil was not treated in the liquid treatment systems. Waste oils were treated based on a biodegradable disposal process developed in Oak Ridge. At the request of the Environmental Control Department, maintenance services prepared the X-231A oil biodegradation plot south of Building X-600. This practice began in the 1970s and lasted into the 1980s. During this period, approximately 24,500 gallons of waste oil contaminated with solvent and radionuclides, 124,300 pounds of oil-soaked fuller's earth, 60 gallons of TCE, and 1,000 gallons of chlorinated solvents were applied at the X-231A oil biodegradation plot. The uranium concentration at the plot averaged 5,000 mg/L. Correspondence from this time indicates several problems in operating and controlling the waste, including the presence of drums, which increased the risk of an uncontrolled oil release. Resource limitations prevented the proper application of fertilizer and the required tilling and/or disking activities. Over time, controls were implemented to

Biodegradation Plots (Beyond Cooling Towers)

prevent regulated waste streams from being placed on the plots; however, a June 1982 OR appraisal indicated that these controls were not always effective. A second plot (X-231B) continued to be used after the X-231A plot was closed in 1977. A July 1984 State of Ohio EPA inspection of X-231B found that no records were kept on quantities of solvents applied, that monitoring was not occurring in the unsaturated zone, and that closure and post-closure requirements needed to be addressed. By 1988, the State of Ohio EPA sent a notice of intent to file suit for hazardous waste violations. These violations included: operating the X-231B oil degradation facility without a permit; failing to establish an unsaturated zone monitoring program for X-231B; and placing hazardous waste on the X-231B plot without establishing a land treatment program or demonstrating that the waste would be completely degraded. As a result, the plot was closed and monitored for the presence of volatile organic compounds, PCBs, metals, and radioactive constituents.

As concerns regarding the management and disposal of PCBs increased in the early 1970s, both Monsanto and the AEC provided safety-related information to the Plant. In 1979, the Plant provided guidance to workers on the disposal of PCB-contaminated items. Disposal limits were set, and potential sources were evaluated for the presence of PCBs, which led to the discovery that very large gaskets in the process building ventilation systems had been treated with PCBs. These gaskets had been dripping oil that was found to significantly exceed the regulatory limit for PCBs of 50 ppm. In 1983, the Environmental Control Department determined that Chemical Operations personnel were mixing the absorbent material used for cleaning the drips with the regular floor sweepings before this mixture was sent to the

landfill for disposal. The drippings were also radioactive because the ventilation systems handled air from contaminated areas in the process building. The problems with management of PCBs required PORTS to work closely with EPA, and although some progress was made, a 1988 internal DOE memorandum stated that "the overall effort is entirely insufficient to meet the commitments made to EPA." The Tiger Team assessment also identified the absence of formal PORTS procedures to fully implement PCB cleanup standards, and as a result, a PCB implementation team was established.

Attempts were made to clean ventilation ducts to remove the collected contaminated oil; however, the extent of the problems indicated the need for a different approach involving a collection system consisting of troughs below each gasket and connected to drain lines. The collected liquids were managed as contaminated PCB waste that was later determined to have RCRA constituents. Criticality concerns dictated that the liquids be collected in polyurethane bottles to maintain configuration control until the radioactive content could be determined. Although USEC leases and operates the process buildings, this operation remains a DOE responsibility since PCBs are considered a DOE legacy waste.

In addition to PCB in the gaskets and electrical transformers, PCBs were also found in other locations and processes at the site. Historical review of records and transcribed interviews indicate that PCBs and uranium-contaminated oil were sprayed on gravel roads around PORTS as a means of dust suppression. The presence of PCB-contaminated sludge at the site's sewage treatment plant (the sludge had been used as fertilizer), drying beds, and concrete walls resulted in development of a 1983 *Operating Method for Handling Polychlorinated Biphenyl (PCB) Waste*. In the early 1990s, an incinerator at Oak Ridge was permitted to combust PCB waste that, due to radioactive contamination, could not be handled at commercially licensed TSCA disposal facilities. However, the limited capacity of the incinerator, combined with the large waste volumes from the sewage treatment plant, the gaskets, and personal protective equipment used during drip and spill cleanup, has resulted in the majority of this TSCA waste remaining in DOE Material Storage Areas in process buildings.

As RCRA regulations were being developed, PORTS identified resources and processes that would be necessary for compliance. A 1980 OR Environmental Management appraisal indicated progress in characterizing and handling hazardous waste. These actions began in early 1980 at the request of OR. As a generator, the Plant obtained EPA number OH890008983, which allowed hazardous waste to be sent to offsite disposal vendors. PORTS developed permit applications for those facilities that would be used to treat, store, and dispose of hazardous waste. Additional actions included identifying all waste streams and the current disposal path. Ultimately, the Plant did not submit permit applications because DOE determined in 1980 that all AEC authorized activities were exempt from RCRA, although DOE did finalize development of a system to manage hazardous waste. The Environment Control Department was the lead PORTS organization in implementing these actions, supported by numerous other departments. The Maintenance Division was tasked to operate the X-752 Warehouse as an "interim status" RCRA facility after the facility had been modified to meet interim standards. A Plant waste manifest system was developed to obtain information mandated by Federal regulations for processing offsite manifests.

Although actions were taken to identify and then control regulated waste, these actions were not always effective. As a result, regulated waste was discovered in several non-permitted facilities on the site, which then required a costly RCRA closure and the loss of a feasible disposal option. As an example, between August 1984 and June 1985, approximately 85,000 pounds of metal hydroxide sludge from the X-705 raffinate was incorrectly disposed of as non-hazardous waste based on an initial characterization; this material later failed the EP Toxicity (leachability) Test for cadmium. Since this sludge had been disposed of in the X-749 radioactive burial ground, the State of Ohio EPA required a RCRA closure.

After a June 1987 EPA and DOE agreement specifying that RCRA requirements did apply to DOE facilities, permit applications were submitted to both EPA and the State of Ohio EPA. These applications included the X-752 facility and later the X-744G storage facilities, as well as several liquid and solid disposal facilities that are discussed in other sections of this report. Although the X-744G facility had been used for several years to store spent chemical trap materials, miscellaneous dried sludges, and ash from the X-705 incinerator, it was not until the late 1980s that sampling identified the presence of RCRA wastes in several of these waste streams. Due to security requirements for storing specific levels of radioactively contaminated waste, the X-326 L Cage was also added to the permit application.

Numerous inspections by the State of Ohio EPA, DOE (e.g., Tiger Team assessment), OR, and internal organizational elements continued to identify performance problems in the treatment, storage, and disposal of hazardous waste. Primarily as a result of the Tiger Team assessment and the State of Ohio EPA inspection, the waste management function was centralized in 1990s under the newly created Waste Management Department. This Department implemented many improvements, including locating dedicated field services representatives in the major facilities to assist generators with waste packaging and characterization. A very conservative approach was adopted whereby waste was considered hazardous unless clearly shown to not meet regulatory thresholds. This conservative approach, combined with a DOE moratorium on shipping radioactively contaminated waste off site, required development of increased storage capacity for mixed and hazardous waste. Therefore, in 1990 PORTS requested that the State of Ohio EPA grant an exemption allowing storage of hazardous material in the X-7725 facility without a permit. Following this request, the X-7725 facility was upgraded as a compliant permitted RCRA facility. This facility currently stores all Plant mixed and hazardous waste, with the exception of the mixed hazardous waste that has special security requirements and remains in the X-326 L Cage.

Radioactive Waste Management

In the early days of Plant operations, the desire to recover uranium dictated controls for handling contaminated materials. Highly contaminated equipment and scrap metals were decontaminated for the recovery of enriched uranium before disposal, resulting in removal of loose contamination before the equipment or waste materials were buried or further processed on site. X-749 was the main disposal site for low-level radioactive waste (LLW). Additionally, key elements of the PORTS radioactive waste management strategy have been the burning of contaminated oils in trays, salamanders (a primitive device consisting of an upright tube mounted on a base), and incinerators and smelters.

Open burning of contaminated oils occurred from the 1950s into the 1970s. In 1959, a nuclear safety evaluation of criticality concerns in the X-705 area reported that unsampled hydrocarbon oils were being burned in three 18-inch diameter salamander oil burners. Several former workers involved in this operation stated that these oil burners were used on the west side of X-705 and that the residual ash was collected for reprocessing. A 1973 OR health protection appraisal revealed that the smoke from the salamanders (believed to contain phosgene gas) was introduced into the ventilation system and released into the X-705 high bay.

Starting in the mid-1950s, two oil-fired incinerators were installed and used to thermally decompose waste materials. One was used to destroy security burnables; the second was used for uranium - contaminated wastes generated from Plant operations. Several former employees stated that this second unit burned solid and liquid wastes and routinely produced heavy black smoke. Little documentation regarding the operation of these units was available; however, the 1962 OR health physics review stated that the incinerator was equipped with a cyclone-type filter and was not a significant contributor to environmental contamination. A 1970 internal Goodyear Atomic Corporation memorandum indicated that funds had been approved to replace the existing incinerators because they were inefficient, needed repair, and did not meet smoke and particulate emission standards.

In 1971, a pre-engineered incinerator was installed on the south side of Building X-705 at the same location as the previous waste incinerator. An air pollution source permit for operation of the incinerator was filed with the State of Ohio in 1976, and the incinerator was placed on the State registry. Several years later, an enclosure with support facilities was constructed. The Radicator (the manufacturer's product name used by Plant employees) served an important role at PORTS in the destruction of burnable waste materials collected from approximately 100 Plant locations. Use of the Radicator allowed valuable space in the X-749 low-level waste landfill to serve other uses. Incinerator ash was sampled, and if economically beneficial, the ash was sent to the X-705 uranium recovery facility. Ash with lower levels of uranium was boxed and disposed of in the X-749 landfill. Operators indicated that during the CIP/CUP initiative in the 1970s, floor sweepings were collected from areas where classified components were managed and incinerated, and the resulting ash was disposed of in the X-749A classified landfill.

A number of problems were encountered with operation of the Radicator. A July 1972 memorandum noted that winds scattered contaminated burnables and caused fine-particulate incinerator ash to become airborne, presenting a health physics hazard to personnel in the area. Although the Radicator was to be smokeless, there were periods when smoke was

observed by employees at the incinerator and by occupants of a nearby building. In 1984, the Radicator was smoking due to the heavy plastic disposal demand, which caused incomplete combustion. A Plant-wide notice directed operating organizations to deposit plastics in scrap barrels, not in burnable barrels. In 1986, two events occurred involving malfunction of the Radicator, causing the intake of smoke into the ventilation system of Building X-700, located only 200 feet from its stack. An incident report noted that the Radicator was improperly loaded with non-combustible items, that atmospheric inversion conditions prevented the vertical movement of stack gases, that deteriorating refractory lining caused heat loss and incomplete combustion, and that there was a lack of a preventive maintenance program.

Radicator operating limits were not clear to the operators, resulting in inappropriate introduction of oils and solvents to the incinerator. According to PORTS documents, between August 1984 and April 1986 the operators improperly introduced used oil and solvents into the incinerator to enhance combustion. In response to this discovery, on August 8, 1986, OR ordered that the Radicator be shut down pending development of specific procedures regarding receipt of acceptable wastes. The State of Ohio subsequently revoked the facility's registration status. Subsequent testing of the oils, solvents, and incinerator ash determined it to be hazardous waste pursuant to RCRA due to the presence of cadmium and barium. The facility never restarted and was closed under RCRA authorities in the 1990s. The termination of Radicator operations has contributed to the buildup of 1700 containers of legacy burnable waste materials that are currently stored on site. Additionally, the Plant continues to store residual incinerator ash. Analysis of this ash indicated that it contains enriched uranium and trace quantities of neptunium, plutonium, and hazardous metals. The operation of the incinerator also impacted the environment surrounding the facility, primarily through airborne particulates from the incinerator and through spills and runoff from the storage lot.

The X-749 landfill reportedly received alumina-trap residue, aluminum oxide, sodium fluoride, and incinerator ash totaling 134.2 cubic feet in 1961 when the AEC began requesting maintenance of disposal records for LLW burial. Throughout the 1960s and the early 1970s, annual disposal volumes remained in the hundreds of cubic feet, with a high of 468 cubic feet in 1965. In 1976, a report on LLW disposal at PORTS stated that much of the chemical trap material contained technetium-99, which is highly water-soluble. After that finding, this material was placed in sealed packages; however, this action followed nearly 20 years of disposal of chemical trap waste without the benefit of sealed containers. The report recommended no changes in the burial practices, since there was no evidence that solid radioactive wastes were leaching into the groundwater. In an apparent contradiction, the report recommended that percolation rates, infiltration rates, and porosity tests be conducted to determine the need for future changes in burial practices. Also recommended was the establishment of guidelines on the structure of burial containers, recognizing that using aluminum canisters for chemical trap material "obviously will confine fluorides and long-lived radionuclides for only a limited time."

Controls for disposal at X-749 were increased, and sealing of trap material continued. However, not until 1979 was action taken to develop a burial ground operating specification and provide training to address burial ground operations. In addition to the waste discussed above, contaminated roofing material, asbestos, concrete, light bulbs, and other non-burnable waste were disposed of in the trenches. Due to the inappropriate burial of waste that was determined to be regulated under RCRA, the landfill was closed at the direction of the State of Ohio EPA. Since the closure would significantly impact the site's disposal options, a concerted effort was made to place all waste that met regulatory limits in the landfill before it closed on May 15, 1990. This led to disposal of large volumes of waste that included contaminated vehicles, equipment, and the contents of large converter shells.

Burial of classified material and waste in X-749A began shortly after the Plant began operating. Early controls focused on meeting security requirements. Records show that very large amounts (250 to 300 tons) of material were disposed of, including tube sheets, and related hardware; classified floor sweepings; compressor blades; and other classified parts and records from the Plant. Extensive discussions with PORTS personnel indicate that, with one exception, only material used in or in support of the gaseous diffusion processes was buried in X-749A. This exception occurred in 1987, when two boxes of specimens from Bettis Atomic Power Laboratory were buried. Details on the contents of these two boxes are discussed under Work for Others in Section 3.2.8.

One of the largest items buried in X-749A was a nickel plant from Huntington, West Virginia. This plant, called the INCO (International Nickel Company) Nickel Plant, had been built in 1951, used until 1963, then maintained by INCO on backup status until the

AEC decided that the plant was no longer required. This plant had provided material to the Department's gaseous diffusion plants. Since the plant contained material and equipment that was still considered classified, a decision was made to bury the plant at PORTS. Investigations by a PORTS industrial hygienist identified several health and safety concerns, including asbestos and nickel carbonyl. Sampling of residual material and surfaces also indicated the presence of uranium. Special precautions were required for the asbestos, and National Emission Standards for Hazardous Air Pollutants were applied to the removal and burial activities. The demolition, transport, and burial involved personnel from OR, PORTS, the plant owner (INCO), and two subcontractors. INCO supervised the demolition activities that began in late 1978, resulting in over 50 truckloads of material being transported to PORTS for burial in the classified landfill.

4.2 Management and Disposal of Scrap and Surplus Materials

Large volumes of scrap metal and surplus material were generated during construction, maintenance, repair, and facility upgrade activities at PORTS. These materials were either managed as waste or stored and managed as a commodity for resale. Much of the material was contaminated, and large volumes were disposed of on site. Additionally, large volumes of scrap remain in storage at the Plant pending future disposal or disposition.

Records indicate that Goodyear Atomic Corporation management was aware as early as the 1950s that contaminated surplus materials could only be shipped to properly licensed and authorized recipients, and that radiological monitoring of all potentially contaminated materials being offered for public sale was required. The handling and disposal of scrap materials were subject to a corporate waste management procedure that defined the manner of disposal and proper segregation for the different types of scrap and waste material generated. While contamination limits and specific categories changed somewhat over the years, scrap material was required to be segregated by contamination status. Drums or other containers were provided for each of the categories wherever significant quantities of scrap were generated. Containers were supposed to be marked to indicate the type of material that could be discarded in each. Line supervisors were responsible for ensuring that employees segregated all scrap materials appropriately; however, this requirement was not implemented consistently, resulting in the presence of contaminated items at designated clean locations. Many workers who were interviewed do not recall being required to segregate scrap materials and claim they simply placed all scrap materials into the same waste containers. Once containers were full, they would be removed by the Materials and Service Department and taken to the appropriate storage or disposition location. Material categorized as clean scrap was taken to the clean scrap yards for placement and preparation for public sale. Contaminated materials were managed as discussed in Section 4.1 or were sold to properly licensed recipients.

Contaminated aluminum presented unique challenges due to the large volume generated, and was often sent to the onsite smelter to be melted and cast into ingots for subsequent rework or reuse for Plant components or for public sale. These ingots were the subject of continuing concern due to the lack of requirements governing acceptable levels of volumetric contamination. Some ingots containing up to 75 ppm uranium and 1000 dpm/100 cm^2 of surface alpha activity were authorized by AEC for sale on the open market in the 1960s. A requirement to include the uranium content of the ingots was a condition of all such sales. AEC also urged disposition of aluminum ingots wherever possible by reworking into components for cascade use rather than public sale. Public sale of contaminated ingots was later discontinued due to the lack of definitive regulatory limits, which continues to present day.

Monthly Industrial Hygiene and Health Physics reports document that Goodyear Atomic Corporation conducted radiological surveys for other types of scrap

X-752 Scrap Yard

and surplus materials released from the Plant via public sale. A 1958 report lists a total of 28 sales, with the monitoring of an estimated 1,346 gross tons of scrap metals. In addition, surplus items, such as 84 vehicles and electrical, plumbing, chemical, and fire fighting equipment, were surveyed for contamination prior to release. A number of similar records and reports addressing radiological monitoring of scrap materials were reviewed during the investigation.

Despite the knowledge and proper corporate health and safety procedures instituted by Goodyear Atomic Corporation for scrap sales, the program encountered a number of problems, highlighted in internal memoranda and documents that began appearing in the mid-1970s. A September 1976 memorandum from Industrial Hygiene and Health Physics advised that insufficient manpower had resulted in an inability to survey each load of scrap unloaded at the concrete pad near Warehouse 15 and that recent surveys had identified a number of contaminated items. The problem escalated to a point that in September 1979, Industrial Hygiene and Health Physics recommended discontinuing the sale of scrap materials, based on concerns identified during an internal audit of the clean scrap yard. The problems included equipment directly associated with process gas, including blades, instrument lines, and peanut valves, present in material being loaded by a buyer. Surveys of these items indicated they were " highly contaminated." The buyer also stated that he had previously purchased similar items; no evidence was provided to indicate that the Plant conducted any follow-up actions. Other concerns included observing unmonitored scrap and debris being dumped into the yard and handled by the buyer without the use of gloves. In addition, process housings with visible contamination were observed in the yard. In 1980, Goodyear Atomic Corporation issued a revised plan for control of scrap and trash material, along with a revised waste disposal procedure. Despite these changes, additional problems were noted in 1981 and 1982 during follow-up inspections at the clean scrap yard.

It is clear that the Industrial Hygiene and Health Physics Department was aware of problems and made significant efforts to properly segregate contaminated materials from clean materials intended for sale to the public. However, given that the responsibility for proper scrap handling rested with line management and that only a small number of qualified health physics personnel was available to perform radiological surveys, it is evident that material exceeding appropriate radiological release guidelines was released from the Plant periodically from the 1950s through the 1980s.

4.3 Liquid Effluents

- *Regulated Outfalls*
- *Routine Historical Discharges*
- *Accidental Spills*

Liquid effluents have been routinely discharged from the Plant and from accidental spills and releases. Effluents were historically released in a number of ways, including via the sanitary sewage and storm water drainage systems. Effluent material that was not otherwise held up or recovered through wastewater treatment facilities and recovery systems flowed to the various Plant outfalls and ditches and ultimately into the Scioto River. Little Beaver Creek, which received effluent from the east and north sides of the Plant, received the vast majority of Plant effluents and discharged into Big Beaver Creek. Big Beaver Creek flows into the Scioto River.

The environmental monitoring program at Goodyear Atomic Corporation was initiated in 1955. Since that time, effluents have been analyzed for radioactive contaminants from the Plant's east and west drainage ditches and the south holding pond. Additionally, cooling water blowdown was monitored for chromium prior to being piped directly to the Scioto River. The Ohio Pollution Control Board adopted standards to govern public water supplies in April 1970. Goodyear Atomic Corporation established an Environmental Control Committee during April 1971 to determine the most effective program to ensure compliance with the new regulations. The Goodyear Atomic Corporation Environmental Control Department was created on June 1, 1971, to be responsible for compliance with the new regulatory activity. This department expanded as additional regulations were established.

Regulated Outfalls

In the early 1970s, the Clean Water Act established the National Pollutant Discharge Elimination System (NPDES), which administered effluent limitations and water quality requirements for chemical releases. In 1973, sampling began in support of the NPDES permitting process whose requirements were finalized in 1975. In 1976, a chromium reduction facility for

treating cooling water blowdown before it was piped to the Scioto River was built to meet the requirement of the NPDES permit. Liquid discharge locations were maintained and monitored by the DOE and regulated by the State of Ohio.

Over the years, monitoring data from the Plant outfalls have been distributed as part of the annual site environmental report. The number of regulated outfalls has varied with Plant expansions and improvements. In the mid-1980s, there were as many as 18 NPDES outfalls, including the east drainage effluent, the X-701B holding pond, the south holding pond, the sewage treatment plants, the recirculating cooling water blowdown, X-611 sludge lagoon outfalls, and the three former Gas Centrifuge Enrichment Plant outfalls. Chemical parameters routinely monitored at the outfalls included total dissolved solids, biochemical oxygen demand, total suspended solids, oil and grease, total residual chloride, trace metals, nitrate, and ammonia. Liquid effluent discharge limits for radionuclides were not specifically promulgated by EPA but were always required and published under the AEC and ERDA regulations and later documented in DOE orders as maximum permissible concentrations or radioactive concentration guides in water. Despite the discharge restrictions, it is clear that enough radionuclides and chemicals have been released to create legacy environmental contamination. The existence of legacy contamination has been confirmed through environmental sampling data.

The X-615 sewage treatment facility was built in 1953 as part of the original infrastructure during Plant construction. The facility was intended to receive conventional sanitary waste from the process and support buildings, from such sources as sinks and floor drains. The facility was designed as a secondary treatment system using a primary clarifier, a high rated trickling filter, and a secondary clarifier with provisions for recirculation through the trickling filter. In the 1970s, a post-chlorination process was added to treat the effluent before discharge to the Scioto River. The influent to X-615 contained radionuclides, resulting in the generation of digested sludge that contained LLW. The sludge was either spread on the land adjacent to X-615 or used as fertilizer at PORTS. In the 1980s, PCBs were found in the sludge, resulting in the sludge being boxed and stored. The X-615 sewage treatment facility was replaced with X-6619 during the construction of Gas Centrifuge Enrichment Plant facilities in the mid-1980s. The X-6619 sewage treatment facility is an activated-sludge facility utilizing the plug flow process, aerobic digestion, secondary clarification, and granular-media filtration for effluent polishing (tertiary treatment). This plant received sewage and non-conventional wastewater, such as the X-705 laundry effluent, mobile equipment maintenance shop discharge, and developer and fixer used in x-ray and microfiche development. In addition to receiving sanitary effluent from the process and support buildings, the new sewage treatment plant received effluents from the three DOE remediation pump and treat facilities. In these DOE facilities, groundwater is treated for VOCs and then the effluents containing uranium, thorium, technetium and trace transuranics are released to X-6619. The sludges from X-6619, contaminated with radionuclides and PCBs, are boxed and stored as mixed TSCA and radioactive waste. The facility effluent is discharged into Outfall 003, the upper end of a subsurface pipeline to the Scioto River.

The NPDES outfall that contained the recirculating cooling water (RCW) normally had the highest flow rate and volume. Over the years, the treatment of the RCW has been improved in order to remain in compliance with NPDES standards. At the onset of Plant operations, hexavalent chromium had been used as a corrosion inhibitor in the eight cooling towers at the Plant. In 1976, hexavalent chromium was reduced to the less toxic, trivalent form in the X-616 chromate reduction facility, thereby eliminating the more toxic, hexavalent chromium from the discharge stream. In 1991, PORTS converted the RCW treatment from a chromium-based corrosion inhibitor to a non-hazardous phosphate-based inhibitor. Currently, the RCW is discharged to the Scioto River through a separate pipeline.

Routine Historical Discharges

Historically, the most significant liquid radiological effluent source was from the X-705 Decontamination Building, which has been used since 1955 for decontaminating and monitoring equipment exposed to uranium compounds and for recovering uranium from decontamination solutions. Operations within the X-705 Building, described in Section 3.2.4, include equipment decontamination, uranium recovery, uranium hexafluoride cylinder decontamination, a laundry service, and a chemical laboratory. The operation of this facility resulted in the release of significant quantities of chemicals, uranium, technetium, and smaller amounts of plutonium and

neptunium into the environment through the X-701B holding ponds.

Most X-705 process effluents have historically been discharged to the X-701B holding pond. The last rinse booth of the large equipment decontamination tunnel was converted to a recirculating system upon the deactivation of X-701B in 1988. In 1977, interdepartmental correspondence documents that effluents from the cleaning facilities were found to be bypassing the X-701B holding pond and discharged directly to the east drainage ditch leading to Little Beaver Creek. A contract was let to divert the effluent to the X-701B holding pond after this condition was discovered.

Uranium recovery for the entire Plant was accomplished at a solution recovery facility located within X-705. Feed solutions were digested with nitric acid, then concentrated, extracted, and calcined to produce uranium oxide. Effluents were discharged to the X-701B holding ponds. Solutions from this process were subsequently treated by a microfiltration system that was installed in 1988. This system uses microfiltration and pressure filtration technology to treat all process waters produced in the X-705 Building. Nevertheless, in the past, uranium has been the principal radioactive constituent released to the X-701 holding pond, comprising 92 percent (76.5 kg) of the total radioactivity in 1969 and 90 percent (117.0 kg) of the total in 1970.

The X-705 facility also provided laundry services for protective clothing and operated a chemical analysis laboratory. Dilute chemical solutions were discharged to X-701B during its operation. Various other sources of discharge from X-705 are known to have occurred. Some floor drains in X-705 discharged to X-701B prior to 1988. This discharge was estimated to be about 400 gallons per month. Foundation drains, roof drains, steam condensate, and cooling water were discharged via two basement sumps, each averaging 8,800 gallons per day. One of the sumps discharged into X-701B prior to 1988. Currently, the basement sump effluent is piped to the X-622T treatment facility, where it is treated through carbon filtration.

X-701B Holding Pond

Starting in 1975, Plant records reveal that elevated technetium and transuranic contamination was unexpectedly discovered in liquid process effluents from the X-705. Before then, radiological effluent monitoring was only conducted for uranium and indicator parameters. The PORTS environmental monitoring program did not include these contaminants, which were known by Plant management to have been introduced into PORTS industrial facilities from the processing of reactor returns and from Paducah production feed material. Based on the information collected, it does not appear that personnel responsible for environmental monitoring were aware of the presence of these contaminants at PORTS.

In September 1975, the beta-gamma activity in the east drainage ditch sharply increased, judging by samples from the east drainage ditch immediately before it joined Little Beaver Creek. The Chemical Analysis Department identified the major source of this activity as beta radiation from technetium-99. The weekly sample collected on September 29, 1975, showed a technetium-99 concentration of slightly in excess of the discharge concentration guideline for uncontrolled areas. Studies by the Process Technology Department indicated that all of the technetium in the drainage ditch originated at X-705. Major radioactive effluents at X-705 were temporarily curtailed until a remedy could be put in place. By December 1980, technetium-99 levels in the discharge from the east drainage ditch had increased by approximately 350 percent over previously reported levels. Mass balances performed based on technetium-99 discharged from X-701B and Outfall 001 showed that the technetium-99 from Outfall 001 was being discharged from the X-705 Building through the X-701B holding pond. Uranium recovery raffinate discharges accounted for approximately 25 percent of total discharges of technetium-99. Other operations that had resulted in elevated technetium-99 discharges in the past were investigated and cleared. It was determined that most of the technetium was associated with rinse water from the equipment decontamination tunnel, which bypassed the uranium recovery system. The increase in technetium-99 discharges occurred shortly after the initiation of equipment changeout in the X-330/X-326

process buildings. A technetium treatment system was proposed in the late 1970s and installed in the early 1980s to reduce the levels being discharged into the environment.

By 1976, transuranics had also been identified in raffinates generated by the recovery of uranium from contaminated equipment and materials processed in X-705. These raffinates were discharged to the X-701B pond. Subsequent monitoring detected transuranics at significant levels in sludges from this pond and in the effluents from the pond to the east drainage ditch. Transuranics in the effluent originated primarily in reactor-return materials processed in the X-705 Building. As an outcome of these findings, a committee was formed in December 1976 to study Plant-wide aspects of the transuranic contamination. Developing more sensitive analyses for transuranics was among the top priorities. At the time, the Goodyear Atomic Corporation analytical procedures had a limit of detection that was equal to about 7 percent of the ERDA recommended concentration guide for neptunium-237. The committee determined that the detection limits would have to be lowered to increase the effectiveness of the environmental monitoring program. In 1977, Goodyear Atomic Corporation investigated transuranic contamination in sediments in Little and Big Beaver Creeks and identified low levels of plutonium and neptunium contaminants at some of the locations sampled. Sampling for transuranics in environmental media was terminated in the mid-1980s and until recently has not been a priority of the site.

The X-701B holding pond was a major effluent source to Little Beaver Creek. It was an unlined pond used for the neutralization and settling of metal-bearing waste water, solvent-contaminated solutions, and acidic waste water. Most of the waste discharged to the pond originated at the X-700 Chemical Cleaning Facility and the X-705 Decontamination Building, which was described previously. The X-700 Chemical Cleaning Facility contained, among other cleaning processes, two vapor degreasers, one of which had been in operation since 1955; the other had been used from 1955 until the early 1980s, when it was deactivated and removed from the building. TCE was used for degreasing until 1987; 1,1,1-trichloroethane has been used since. Floor drains in the basement of X-700 previously emptied into a ceramic pipe that discharged into a sump in the basement of X-700. The sump contents were then discharged to the X-701C pit, prior to entering the X-701B holding pond, until the pit was closed in 1988. This was a major source of TCE in X-701B and the entire east drainage ditch area.

From 1974 until 1988, slaked lime was added to the X-701B influent to neutralize the low pH and induce precipitation of uranium and trace quantities of transuranics. This precipitation caused a large amount of sludge to accumulate in the pond and necessitated annual dredging of the sludge. The X-701B holding pond was constructed early in Plant operations and received process discharges until November 1988.

Accidental Spills

In addition to the continuous discharge of process waste to primarily Little Beaver Creek, there have been numerous spill events throughout the history of the site. A variety of historical spill events and accusations of spills were reviewed as part of this investigation. The Ohio EPA emergency response records from 1978 to 1988 contained 23 reported spills at the Plant. Six of the reported spills affected watercourses adjacent to the Plant. Site records indicate dozens of other spills that were identified and investigated by Plant management. Materials commonly spilled were UF_6, PCB oil, and sodium hydroxide. Other materials spilled include road binder, chlorine wash water, ferric sulfate, gasoline, mercury, Freon, sulfuric acid, TCE, uranium, and lubrication oil.

Several fish kills in surrounding creeks have resulted from spills at the Plant. Ohio Department of Natural Resources fish kill records from 1970 to 1986 contained eight fish kill investigations. Over the years, most kills were due to oxygen depletion in the stream water rather than toxic conditions caused by hazardous chemicals. Instances of fish kills include:

- In 1955, a fish kill occurred in Little Beaver Creek as the result of the oxygen balance being temporarily upset by lignins washing from the X-633 cooling tower, causing a noticeable dark brown color in Little Beaver Creek.

- On April 17, 1978, several hundred dead fish were discovered in Little Beaver Creek, downstream from the confluence of the east drainage ditch. After a site investigation, the only anomalous condition discovered was the presence of elevated metal (aluminum, nickel, copper, and zinc) concentrations in the fish and creek sediments. The source of these metals was determined to be the X-701B holding pond.

- On January 24, 1980, Environmental Control Department surveyors discovered a high pH discharge at the east drainage ditch outfall. Further

investigation revealed the presence of sodium hydroxide (caustic soda) from the X-330 Nitrogen Plant in Little Beaver Creek and a number of dead minnows.

- On October 31, 1983, a fish kill due to a sodium hydroxide spill killed approximately 5,800 fish in Big Run Creek and resulted in restitution to the Division of Wildlife.

On occasion, nearby property owners have filed complaints of cattle kills with the Plant. PORTS personnel conducted a number of investigations; however, Plant emissions were not identified as a contributing cause in these investigations. One such case occurred in January 1955, when six dairy cows died on a dairy farm near the town of Wakefield. The farm was adjacent to Big Run Creek, and the owner associated the deaths in the herd with activities at the Plant. Onsite and offsite sampling of the creek was performed directly above the farmer's property. Autopsy findings and the stream water analytical results did not link the deaths of the animals to Plant discharges. This conclusion was reinforced when the results of experiments with white rats were reviewed. Creek water from the drainage near the farm was given to the rats for a period of two weeks, and they developed no clinical signs of illness.

4.4 Atmospheric Releases of Radioactivity and Fluorine/ Fluorides

- *Stack Emissions*
- *Accidental Releases*
- *Diffuse and Fugitive Emissions*
- *Planned or Unauthorized Releases*

Radioactive and fluorine/fluoride air emissions to the atmosphere began with Plant startup in 1954 and have continued to the present from USEC operations that are regulated by NRC. The sources of air emissions were process stacks (which included routine releases), diffuse and fugitive emissions, accidental releases, and some likely planned or unauthorized releases. During the early years of Plant operation, environmental monitoring activities focused primarily on characterizing liquid effluents to ditches and streams. Air sampling at various onsite and offsite locations was not initiated until the mid-1960s in an effort to better characterize and analyze the potential impact of radiological and non-radiological contaminants (e.g., fluorides) on the public and the environment.

PORTS has estimated that approximately 10,545 kg of uranium, comprising approximately 8 Ci, and 27 Ci of technetium-99 have been released to the atmosphere from 1955 to 1993. These emissions and the potential resulting population dose were reported by OR as the lowest of the three gaseous diffusion plants. This may be attributable in part to the increased costs, tighter limits, and related economic factors associated with production of higher assay enriched uranium.

Nearly half of all the estimated uranium released to air at PORTS was attributable to one accidental release from a 14-ton cylinder in 1978. Another 30 percent of the total uranium released is estimated to have been released during the first eight years of Plant operation, during the time that the Feed Production Plant was operational. Uranium releases dropped significantly in 1963, coinciding with the shutdown of the Feed Production Plant. Approximately 19 of the 27 estimated curies of technetium-99 were released in 1982 and 1993, corresponding to increased cleaning and maintenance of contaminated cascade equipment during those periods. While technetium-99 was known to be present in feed materials as early as the mid-1960s, it should be noted that Goodyear Atomic Corporation did not believe that any significant amounts of technetium-99 were released prior to 1975 because of relatively low beta-gamma radiation that had been measured in effluents before then. A marked increase in beta-gamma activity was discovered in 1975, well above that which could be attributed to uranium daughter activity. This led to further analysis and the conclusion that technetium-99 contamination was a potentially significant contributor to radionuclide emissions. While technetium-99 was likely introduced into the cascade feed long before 1975, the expected time period for significant accumulation and its ultimate release from the cascade was never established. The calculations and methods for evaluating radionuclide discharges were not located during this investigation.

The release of fluorides is often closely correlated with releases of uranium, because airborne releases of UF_6 hydrolyze with the water vapor in air to form hydrogen fluoride. However at PORTS, due to Plant design characteristics, fluorine and fluoride compounds were used in significant quantities and were required to be vented directly as waste gases. The baseline quantity of fluorides released annually at PORTS from routine operations has been estimated to be on the order

Roof Vent from X-330

of 20 to 30 tons. Concern over the need to vent fluorine and the associated environmental and human liability problems was expressed in an August 30, 1954, memorandum from the Goodyear Atomic Corporation Portsmouth General Manager to the Goodyear Atomic Corporation corporate legal department in Akron, Ohio. In the memorandum, fluorine was described as an extremely toxic and highly reactive chemical. Potential damage to foliage, crops, and livestock is discussed, as are concerns with exceeding recommended standards for air concentrations to humans. The memorandum also indicated that it was the intention of PORTS to modify Plant design within 6 to 12 months to preclude the need for venting fluorine to the atmosphere under conditions other than an emergency. Follow-up correspondence to this memorandum was not located during the investigation. Venting of fluorine has continued since the initial operation of the Plant.

Stack Emissions

PORTS did not perform continuous vent monitoring of radionuclides or fluorides until the mid-1980s. However, the collection of grab samples and the use of space recorders provided a means of calculating the quantity of fluorides and uranium released through process stacks before then. While space recorders provided a monitoring capability for uranium, this method was far from ideal, and numerous limitations associated with the use of this instrument in emission calculations have been noted over the years, including calibration, maintenance, and procedural problems. For example, a January 1979 memorandum indicated that the X-326 top purge space recorder had been out of service for over one year. There were also recurring contamination problems associated with space recorders that rendered the data from these units unreliable for release estimation. Grab sampling techniques, which could also be used, were considered unacceptably prone to error. A Vent Committee was formed in the early 1980s to study the atmospheric vents, and a report was issued in 1985 recommending that continuous samplers be installed on a number of process vents.

Before 1984, the main source of radionuclide and fluorine releases from routine diffusion operations was the X-326 top and side purge cascade vent streams. Operational changes in 1983 reduced purge cascade radionuclide emissions to within an order of magnitude of the next two largest sources of gaseous emissions—the X-330/X-333 cold recovery and wet air evacuation system vents. Other smaller emission points included the X-345 and X-744G sampling facilities. The Feed Production Plant contributed approximately 407 kg of uranium (0.22 Ci) per year to total sitewide radionuclide emissions from 1958 until its closure in 1962. No estimates of routine releases from the oxide conversion facility were identified, since this facility did not contain process stacks. However, as discussed below, this facility was also a likely source of some radionuclide releases during its operation from 1961 to 1967. In addition to process buildings, the X-342A Fluorine Plant was a source of fluorine emissions.

It is likely that emission estimates have been made in good faith; however, these estimates do not reflect all the potential releases that were possible, including some that could have been significant. While the estimates were generally concerned with radionuclide quantities, similar concerns exist for fluorides. The potential for human error and unmonitored or unauthorized venting of contaminants has always existed at PORTS, partly because of Plant design. The vast piping and valving flexibility associated with the cascade buildings offers many configuration possibilities, including relatively simple means of rerouting both uranium and fluorine release paths to alternative locations, such as those that may be unmonitored. By simply mispositioning or adjusting a few valves, effluent streams can be rerouted to discharge locations other than that specified by the

design basis. For example, the Building X-326 Evacuation Header can still be connected to the "D" Jet, which vents at roof level without going through a trap, by unlocking and repositioning valves, thereby bypassing any monitoring systems.

Accidental Releases

A number of accidental releases have occurred at PORTS, most of which were relatively minor from the standpoint of environmental impacts. Not all documented accidental releases involved atmospheric releases. During the investigation, several lists of accidents were reviewed. One list identified approximately 515 material releases from September 24, 1954, to November 26, 1993. The most significant release occurred in March 1978, when a 14-ton cylinder fell from its carrier and cracked open. An estimated 4,820 kg of uranium escaped into the atmosphere. Total activity was estimated at slightly less than 3 Ci, as the uranium was present at low (natural) assay. Other major releases involved a valve failure on a tails cylinder in October 1978 (releasing 560 kg of uranium and 0.125 Ci), a similar valve failure in 1969 (releasing 460 kg of uranium and 0.102 Ci), and a process malfunction in the side purge cascade in December 1983 (releasing 50 kg of uranium and 0.69 Ci). In addition, a string of accidental releases of mostly depleted uranium during the first five years of Plant operation accounted for essentially all of the known or reported uranium lost to the atmosphere from 1955 to 1958, and 20 percent of the losses in 1959 (the remaining losses came from the Feed Production Plant).

There is evidence that PORTS consistently assessed the potential public dose impact from environmental releases. Dose estimates are provided in annual site environmental reports that summarize all releases for each calendar year starting from the early 1970s. Prior to this time, heavy reliance was placed on ambient air samples for assessing impacts on the public. However, ambient air samples were not always available, and they only measured plumes that were at ground level. Lofted plumes may not have been measured depending on meteorological conditions. For example, plume lofting can occur during accidental releases of UF_6, since an exothermic reaction occurs between the UF_6 and water vapor.

In addition to accidental releases of uranium, a number of releases involving fluorine and/or fluorides have occurred. A July 5, 1973, memorandum from Industrial Hygiene notes a call from the Shift

Cylinder Rupture

Superintendent on July 4, 1973, advising that hydrogen fluoride was being released in copious amounts from the X-342 vent stack. An estimated 30- to 40-foot high column of hydrogen fluoride vapor was observed coming out the vent stack. Other accidental releases of fluorides have occurred; however, because of the need to vent fluorine from the cascade buildings, such planned releases would not be classified as accidental. Despite authorization requirements and standards for the controlled venting of fluorine from the cascade buildings, the system has weaknesses. Personnel at the Plant have made recurring reports of offensive fluorine fumes, breathing difficulty, and in some cases permanent respiratory tract damage. Offsite residents and farmers have complained of odors and damage to crops. Investigations of these complaints generally conclude that the evidence is insufficient to support a causal relationship to Plant venting. For acute cases, there is often no trace of contaminant that remains by the time a response team has arrived to investigate the alleged incident. While ambient fluoride samplers have been used for many years to measure the levels of fluorides in the environment, these samplers average the ambient concentration over a period of several days and may not be sufficient to capture a potential acute fluoride release that could result in health effects over a short duration. Notwithstanding this limitation, a number of results from the ambient samplers have shown actual fluoride concentrations that exceed guidelines established by various states for monthly maximum concentrations.

Diffuse and Fugitive Emissions

Diffuse and fugitive emissions were generally not calculated for the Plant from 1952 through 1993. Workplace air samplers, as well as evidence of

contamination on roofs and grounds, point to unmonitored releases. For example, very high airborne concentrations of radioactive material were prevalent in the oxide conversion facility, which could have been vented to the atmosphere through penetrations, ventilation systems, doors, and windows. A February 1978 AEC memorandum referencing an investigation of the X-705 oxide conversion facility concluded that the area had unfiltered exhaust that draws air away from the high bay area, through the oxide conversion area, and through a roof stack, thereby allowing venting of releases from inside the oxide conversion facility directly to the atmosphere. As discussed in Section 3.2.2, since the facility processed reactor returns, the unmonitored releases from this location could have contained transuranics. No estimates of releases from this facility have been incorporated into sitewide release estimates or dose calculations reviewed during the investigation. After the mid-1960s, the ambient air samplers could reflect some air concentration contributions from diffuse and fugitive sources. Unfortunately, no modeling studies were performed to evaluate the relationship between these samples and emissions. Also, only low-volume samples were taken. This investigation found no information documenting how the low-volume, ambient air sampler performed for a variety of wind and weather conditions.

Planned or Unauthorized Releases

As described in Section 3.2.3, there is evidence that planned releases may have occurred during preparation of the cascade cells for maintenance. Cell jetting may have been performed to reach a desired low concentration of uranium in the cells. These releases would occur from the roofs of the process building or possibly unauthorized locations that bypass monitoring systems. The frequency and amounts of the releases are unknown; however, significant quantities of uranium would normally be available to be released during a single jetting event. While economic considerations would provide a strong incentive to avoid jetting of higher-assay material, for some lower-assay material in the cascade this constraint would have been less significant. Because of the possibly significant quantity of uranium involved, jetting of the cascades could be an undocumented contributor to the estimated quantity of uranium released from 1955 through 1993.

4.5 Environmental Management Summary

Over the operating lifetime of the Plant, activities to manage wastes and liquid and air process effluents evolved in response to internal and external requirements. PORTS personnel monitored emerging regulations and established plans and strategies in response to new requirements. However, implementation of necessary changes and new compliance programs often required an extended period of time and were not always fully effective.

The generation of waste and scrap materials began with Plant construction in 1954, and general guidelines for handling, storing, and disposing of waste existed in the early days of Plant operations. Onsite sanitary landfills likely received some contaminated material, since waste segregation practices were not fully understood or effective. As new requirements were enacted, additional waste streams, such as hazardous wastes, were restricted from disposal in onsite landfills. PCB- and uranium-contaminated oils were spread on roads, disposed of in oil biodegradation plots, burned in open containers, and incinerated.

Implementation of waste management regulations and internal controls was not always effective. The State of Ohio EPA, DOE, and Goodyear Atomic Corporation conducted numerous inspections and identified performance problems in the treatment, storage, and disposal of hazardous waste. By 1988, the State of Ohio EPA sent DOE and the Plant a notice of intent to file suit for hazardous waste violations.

Several important disposal options for the site, such as the X-735 sanitary landfill, the X-749 radioactive waste landfill, and the X-705A incinerator, were lost in the late 1980s and early 1990s because of inappropriate disposal of regulated wastes.

Large volumes of contaminated metal and surplus matter were generated during construction, maintenance, repair, and facility upgrade activities. It is clear that significant efforts were taken to properly segregate contaminated materials from clean materials intended for sale to the public. However, given the known problems in contaminated scrap segregation and the limited number of qualified health physics personnel available to perform radiological surveys, it is evident that material exceeding appropriate radiological release guidelines has been released from the Plant periodically from the 1950s through the 1980s.

Liquid effluents have been routinely discharged from the Plant and from accidental spills and releases. The environmental monitoring program at Goodyear Atomic Corporation was initiated in 1955. Significant changes in liquid effluent discharge practices were required upon the establishment of Federal and state regulations in the 1970s. Several new wastewater treatment systems were constructed to meet new permit requirements and to significantly reduce the levels of radionuclide emissions. Despite the discharge restrictions imposed by the AEC and subsequently the State of Ohio, it is clear that, over the years, enough radionuclides and chemicals have been released into ponds, local ditches, and streams to create legacy environmental contamination. The existence of legacy contamination has been confirmed through environmental sampling data. In addition to the continuous discharge of process waste to local creeks, there have been numerous spill events throughout the history of the site. Spills at the Plant have resulted in several fish kills in surrounding creeks.

Starting in 1975, Plant records reveal that technetium and transuranic contamination was unexpectedly discovered in liquid process effluents from X-705. The Plant environmental monitoring program did not include these contaminants, which were known by Plant management to have been introduced into PORTS industrial facilities from the processing of reactor returns and from Paducah feed materials. Based on the information collected, it does not appear that personnel responsible for environmental monitoring were aware of the presence of these contaminants at PORTS. These discoveries triggered significant efforts by Plant personnel to isolate sources of technetium and transuranic contamination, develop or improve control methods, and establish appropriate monitoring protocols.

Radioactive and fluorine/fluoride air emissions to the atmosphere began with Plant startup and have continued to the present. The sources of air emissions were process stacks, diffuse and fugitive emissions, accidental releases, and some planned releases. Air sampling for radiological contaminants and fluorides at various onsite and offsite locations was not initiated until the mid-1960s. The principal radionuclides released to the air from PORTS operations were isotopes of uranium and technetium-99. PORTS records indicate that nearly half of all the uranium released to the air at PORTS was attributable to one accidental release from a 14-ton cylinder in 1978. Another 30 percent of the total uranium released is estimated to have been from the Feed Production Plant when it was operated during the early years of Plant production.

PORTS was proactive in assessing the potential public dose impact from environmental releases. Dose estimates and release summaries are provided in annual reports starting from the early 1970s. While it is likely that air emission estimates made by PORTS were done in good faith, these estimates do not reflect all the potential historical releases, including some that could have been significant. Diffuse and fugitive emissions were generally not calculated for the Plant from 1952 through 1993. Workplace air samplers, as well as evidence of contamination on roofs and grounds, point to unmonitored releases, including potentially significant releases from the oxide conversion facility. The Plant did not perform continuous vent monitoring of radionuclides or fluorides until the mid-1980s, relying on less precise methods to calculate releases. Evidence also exists that planned releases may have occurred through jetting of process gases from unmonitored vents in preparation for cascade cell maintenance.

Fluorine and fluoride compounds were used in significant quantities at PORTS and were required by Plant design to be vented directly as waste gases. In August 1954, concern over the need to vent fluorine and the associated environmental and human liability problems was expressed by the Goodyear Atomic Corporation Portsmouth General Manager. There have been recurring reports by Plant personnel of offensive fluorine fumes, breathing difficulty, and, in some cases, permanent respiratory tract damage. Offsite residents and farmers have complained of odors and damage to crops. Investigations of these complaints generally conclude that the evidence is insufficient to support a causal relationship to Plant venting. For possible acute cases, a timing problem is evident, in that often no trace of contaminant remains when a response team arrives to investigate the alleged incident. For chronic exposures, environmental monitoring for fluorides has been conducted for many years, and ambient samplers sometimes indicated fluoride concentrations that exceeded guidelines for acceptable concentrations.